

FIELD SURVEYS OF 2004 INDIAN OCEAN TSUNAMI FROM SUMATRA TO EAST AFRICA

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ABSTRACT

On Sunday December 26th at 00:58:53 UTC, a great earthquake with a moment magnitude of 9.0 – or possibly greater (Stein and Okal, 2005) – occurred 250 km southwest of the North tip of Sumatra, Indonesia. Large tsunamis were generated and severely damaged coastal communities in countries along the Indian Ocean, including Indonesia, Thailand, Sri Lanka, India, Maldives and Somalia (Titov et al., 2005). The tsunami death toll is estimated at 300,000.

The authors covered most diverse coastlines impacted by the mega tsunami from the near to the far field encompassing Sumatra (Indonesia), Sri Lanka, The Maldives, Somalia, The Sultanate of Oman (Okal et al., 2006), Madagascar (Okal et al., 2006), Reunion Island, Mauritius and Rodriguez Islands (Okal et al., 2006). A variety of standard tsunami field survey techniques (Okal et al., 2002) were used. The survey teams measured local flow depths based on the location of debris in trees and watermarks on buildings. The maximum tsunami height on flat terrain and the maximum run-up on steep shores were determined relative to the sea level at tsunami impact. Each watermark was localized by means of global positioning systems (GPS) and photographed. Further inundation distances and areas of inundation were documented. Numerous eyewitness interviews were recorded on video to estimate the number of waves, their height and period as well as the tsunami arrival time. In addition overland flow velocities were determined from eyewitness video recordings based on rectified Particle Image Velocimetry (PIV).

In the near field of the epicenter, Sumatra was hardest hit by the tsunami (Borrero 2005). The tsunami severely affected Sri Lanka across the Bay of Bengal at a distance of 1600 km from the epicenter or at a third of the distance between Sumatra and Somalia along the westward path of the tsunami. The authors surveyed both the south and southwest coasts of Sri Lanka as a sub-team of an International Tsunami Survey Team (ITST) during the period January 10 through January 14, 2005 covering some 250 km of coastline between the capital Colombo and Hambantota (Liu et al., 2005). An hour after Sri Lanka the Maldives were hit by the tsunami at a distance of 2500 km from the epicenter or at half way point between Sumatra and Somalia along the path of the tsunami. Subsequent to the Sri Lanka survey the team surveyed a total of 6 heavily damaged islands on 5 different atolls spread over 400 km – including the Islands Vilufushi and Madifushi (Thaa-atoll), Kolhufushi (Meemu-atoll), Kandholhudhoo (Raa-atoll), Eydhafushi (Baa-atoll) and Hinnavaru (Lhaviyani-atoll). Most islands were completely flooded by the tsunami due to their low lying land. At first glance the archipelago with a maximum elevation of 2 m above sea level appears extremely vulnerable. However reports indicate a relatively small number of 82 casualties (Fritz et al., 2006). In East Africa the tsunami impact focused on Somalia some 5000 kilometers

from the epicenter in the main westward tsunami propagation direction. Hardest hit was a 650 kilometers stretch of the Somali coastline between Garacad (Mudung region) and Xaafuun (Bari region), which forms part of the Puntland Province near the Horn of Africa. The tsunami resulted in the death of some 300 people and extensive destruction of shelters, houses and water sources as well as boats. The team surveyed the tsunami impact and wave run-up in the coastal towns of Eyl, Bandarbeyla, Foar, Xaafuun and Bargaal (Fritz and Borrero, 2006).

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